

AMENDMENTS TO THE DRAWINGS

Please replace Figures 1-4 of record with the attached replacement sheets for Figures 1-4.

Remarks

Applicants respectfully request that the Examiner reconsider the present application in view of the foregoing amendments and the following remarks.

The Office Action is non-final. Claims 1, 2 and 4-6 are pending in the present application. Claims 1, 4, 5 and 6 have been amended to further clarify and define the invention. Claim 1 incorporates the textual subject matter of claim 3, now cancelled. Support for the common amendment to claims 1, 5 and 6 can be found on pages 6-7 of the present specification.

Entry of the above amendment is thus respectfully requested.

Filing of Additional Documents

On page 2, item 4 of the Office Action dated November 12, 2009 (hereinafter "Office Action"), the Examiner acknowledges the claim for foreign priority.

Applicants have submitted under separate letter, a certified copy of the foreign application as required under 35 U.S.C. § 119(b).

Objection to the Drawings

The Examiner indicates that the drawings submitted are objected to by the Examiner.

Applicants herein enclose replacement sheets containing Figures 1-4.

Applicants respectfully request reconsideration and withdrawal of the present objection.

Issue Regarding Information Disclosure Statement (IDS)

Applicants are concurrently filing an IDS which contains the references cited within the specification.

Applicants also note that the Examiner has cited the English translation of JP 2003-236929 on Form PTO-892 in the Office Action dated November 12, 2009. Therefore this reference was not included in the concurrently filed IDS.

Objection to the Specification

The Examiner objects to the specification as indicated in item 7 of the Office Action. Applicants herein amend the specification so that the term “fine” is replaced with the term “to scale down” within the specification, as suggested by the Examiner.

Applicants respectfully request reconsideration and withdrawal of the present objection.

Rejections under 35 U.S.C. § 103(a)

The following rejections under 35 U.S.C. § 103(a) are presented by the Examiner.

Claims 1-5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Urairi *et al.*, JP 2003-236929 (hereinafter “Urairi”) in view of Zhao *et al.*, Censors and Actuators, Vol. 65, pp. 209-217 (1998) (hereinafter “Zhao”).

Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Urairi, as modified by Zhao, and in further view of Misawa *et al.*, Laser Applications and Microelectronic and Optoelectronic Manufacturing V, Vol. 3933, pp. 246-260 (2000) (hereinafter “Misawa”).

Applicants respectfully traverse the above rejections.

Examiner's Position:

The Examiner asserts that it would have been *prima facie* obvious to one of ordinary skill in the art to have modified the method of Urairi to include the temperature of Zhao since it allows the thermal shrinkage of patterned polystyrene (plastic) films which provides the basis for a wide flexibility of patterns produced.

With regard to claim 6, the Examiner asserts that it would have been *prima facie* obvious to one of ordinary skill in the art to modify the method of Urairi to include the lens numerical aperture of Misawa since adjusting the numerical lens aperture determines how the pulse is focused.

Based on the following remarks, the Examiner's position is not supportable, thus making the presently claimed invention unobvious over the cited references.

Applicants' Position

The presently claimed invention is directed to a micro-fabrication method which comprises applying a femtosecond pulse laser beam to a plastic material to be processed exhibiting a glass phase transition by heating and having a heat-shrinkage to form laser-processed patterns on the surface of or in the above plastic material to be processed. The formed laser-processed pattern is only scaled down by the heat treatment without its shape being changed. The method includes heat-treating the plastic material to be processed at a temperature not lower than a glass transition temperature T_g to scale down the formed patterns by heat-shrinkage.

In the present invention, Applicants submit the following as to why the shape doesn't change by heat treatment.

The pattern formation by the laser beam, with respect to the plastic material to be processed, is carried out by the fabrication using a femtosecond pulse laser beam. A major feature of the femtosecond laser fabrication is the ability to locally control the rise in heat of the processing part of the plastic material.

For instance, the void made by the femtosecond laser fabrication has already caused shrinkage by the heat generated by the femtosecond pulse laser irradiation, and this fixes the size. The influence of heat by the femtosecond pulse laser irradiation is extremely limited in an area around the void, thus not causing the generation of heat that shortens the distance between voids.

Therefore, although the formed laser-processed pattern is scaled down by the heat treatment, its shape doesn't change since the shape had already reduced in size when it was irradiated by the femtosecond pulse laser.

Differences between the Invention and the Cited References

Urairi

The Examiner acknowledges that the Urairi reference does not disclose a method step of heat treating the plastic material to be processed at a temperature not lower than a glass transition temperature T_g to fine (scale down) the formed patterns by heat shrinkage.

The Examiner also acknowledges that Urairi does not disclose a method in which the formed laser process pattern is only scaled down by the heat treatment without its shape changing.

Additionally the Examiner also acknowledges that Urairi does not disclose a method of heat treating the plastic material to be processed at a temperature (T) equal to or greater than the T_g and equal to or lower than $200^\circ\text{C} + T_g$ ($T_g \sim T \sim T_g + 200^\circ\text{C}$), and that the Urairi reference does not disclose the use of an objective lens of 0.1 to 1.4 numerical aperture.

Applicants submit that the Urairi reference discloses a technique of applying a pulse laser beam to a plastic material exhibiting a glass phase transition by heating for forming an induced structure part on the surface of or in the plastic material.

The purpose of Urairi is to form an induced structure part on the surface of or in the plastic material by irradiation of a pulse laser beam, not to scale down the induced structure part (see Urairi, page 4, paragraphs [0006] and [0007]).

Urairi also discloses that the formed induced structure part would be softened if the ambient temperature is beyond the glass transition temperature T_g of the plastic material (see Urairi, page 7, paragraph [0020]).

Zhao

In contrast to the presently claimed invention, the Zhao reference discloses that thermal shrinkage changes the shape from square to rectangular or rhombic depending on the alignment (see Zhao, page 212, Section 3.2, and Figure 3).

Therefore, based on the above, one of ordinary skill in the art would not have been motivated to combine the technique of Urairi with a method to reduce the feature size of microstructures of Zhao in order to scale down the formed induced structure part.

Applicants submit that although the Zhao reference discloses a method to fabricate microstructures of various materials by heating the patterned film to a few degrees above the glass transition temperature, it is difficult for one of ordinary skill in the art to modify the method of Urairi to include the heat treatment and the temperature of Zhao.

Applicants also contend that the references cited by the Examiner do not disclose a method in which the formed laser process pattern is only scaled down by the heat treatment without its shape being changed.

In light of the above arguments and amended claims, Applicants submit that the assertions made by the Examiner regarding the above references are incorrect, thus making the Examiner's position not supportable. Accordingly, based on the differences between the presently claimed invention and the above references, the presently claimed invention is not obvious to one of ordinary skill in the art.

Regarding the secondary references Zhao and Misawa, they fail to remedy the deficiencies of the Urairi reference, outlined above. Therefore, even if the references were combined in the manner asserted by the Examiner, the result of such combination would still not suggest the claimed invention.

Since claims 2 and 4-6 ultimately depend from amended claim 1, these claims are unobvious over the cited references for the same reasoning above.

Applicants respectfully request reconsideration and withdrawal of the above rejections.

Conclusion

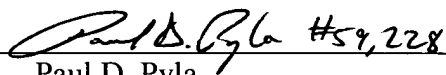
Applicants respectfully submit that the objections and rejections raised by the Examiner have been overcome, and that the present application now stands in condition for allowance.

Should there be any outstanding matters that need to be resolved, the Examiner is respectfully requested to contact Paul D. Pyla at the telephone number below, in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized to charge payment or credit any overpayment to Deposit Account No. 23-0975 for any additional fees required under 37 C.F.R. §§1.16 or 1.17.

Respectfully submitted,

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Attachments: Replacement Figures 1-4

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March 12, 2010